



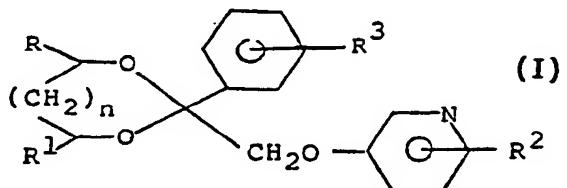
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(54) Title: 2-(3-OXYPYRIDINYL)-1,3-DIOXOLANE AND DIOXANE COMPOUNDS, COMPOSITIONS CONTAINING SAME AND PROCESS FOR CONTROLLING FUNGI USING SAME



(57) Abstract

A compound having structural formula (I), where R and R¹ are the same or different and are hydrogen or C₁-C₆ alkyl; R² is hydrogen, chlorine or bromine; R³ is hydrogen, C₁-C₆ alkyl, C₁-C₆ alkoxy, halogen, trihalomethyl, nitro, cyano, phenyl, phenyl substituted with C₁-C₄ alkyl, C₁-C₄ alkoxy, halogen, trihalomethyl, nitro or cyano, phenoxy or phenoxy substituted with C₁-C₄ alkyl, C₁-C₄ alkoxy, halogen, trihalomethyl, nitro or cyano; and n is 0 or 1 is disclosed. A composition which comprises a fungicidally effective amount of the compound and a carrier therefor is also set forth. In addition, a process for controlling phytopathogenic fungi wherein a fungicidally effective amount of the compound is applied to the locus to be protected is described.

+ DESIGNATIONS OF "SU"

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1 2-(3-OXYPYRIDINYL)-1,3-DIOXOLANE AND DIOXANE COMPOUNDS,
 COMPOSITIONS CONTAINING SAME AND PROCESS FOR CONTROLLING
 FUNGI USING SAME

5 BACKGROUND OF THE DISCLOSURE

1 1. Field of the Invention

10 The present invention is directed to a new class of substituted 2-(3-oxypyridinyl)-1,3-dioxolane and -1,3-dioxane compounds. More specifically, the present invention is directed to a new class of the above noted compounds having particular utility as fungicides.

15 The control of phytopathogenic fungi is of great economic importance not only because fungal growth on plants or on parts of plants such as fruit, blossoms, foliage, stems, tubers, roots and the like inhibit plant production, including the plant's commercially significant portions, such as foliage, fruit and seed, but, in addition, because fungi reduce the overall quality of the plant crop.

20 To control or at least reduce the detrimental effects of fungi, plants have long been treated with fungicides. However, the enormous economic toll taken by known fungi, as well as the continuing development of new fungus strains resistant to known fungicides, establishes a continuing need to develop new and more effective fungicides which possess curative, preventative and systemic action to protect all manner of plants. In addition, these newly developed fungicides must not only provide the above-discussed protection against the detrimental effects of fungi but, negatively, must not possess properties which have adverse effects on the plants to be protected. Furthermore, new fungicides must not have adverse effects on the

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- 1 commercial exploitation of the crop of the plant protect d.
Finally, the fungicide must be free of characteristics which
adversely affect the surrounding environment including the
soil and the surroundings into which the fungicide is
5 introduced.

The above remarks establish the need in the art for
new compounds, distinguished from the compounds utilized in
the prior art, that provide more effective fungicidal
activity, without adverse effects on the plants to be
10 protected or the environment in which the plants are grown,
against the scourge of phytopathogenic fungi.

2. Background of the Prior Art

The prior art includes teachings directed to the
15 use of oxypyridinium compounds that are useful as fungicides.
One such reference is U.S. Patent 4,143,144, issued to Tobol
et al., which discloses certain 2-alkoxy- and 2,6-dialkoxy-4-
halomethylpyridine compounds which find utility as
fungicides. It is emphasized, however, that although the
20 compounds of the '144 patent are oxypyridinium compounds,
they have no relation to any class of substituted 1,3-
dioxolanes or substituted 1,3-dioxanes.

Similarly, U.S. Patent 4,678,504 to Schulz et al.
sets forth another class of oxypyridinium compounds useful as
25 fungicides. The compounds of Schultz et al. are salts of
O-substituted 3-oxypyridinium compounds. More specifically,
Schulz et al. describes benzyl bromide salts of
3-tetradecyloxypyridine, 2,4'-difluorobenzylhydroxypyridine
and the like. This class of salts, like the compounds of the
30 Tobol et al. patent, teach the use of oxypyridinium compounds
as fungicidal agents. However, there is no disclosure,
suggestion or even hint of utilizing 1,3-dioxolane and
1,3-dioxane compounds which include substituted and
unsubstituted 2-(3-oxypyridinyl) substituents.

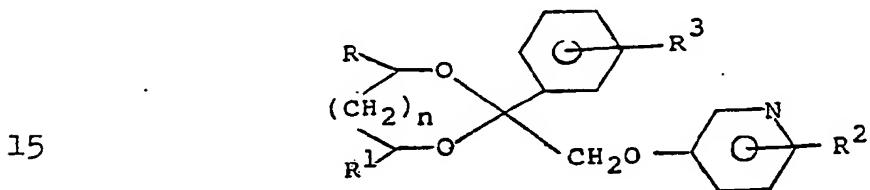
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1 BRIEF SUMMARY OF THE INVENTION

A new class of compounds have now been developed which not only provides excellent protection against the ravages of phytopathogenic fungi but does so without adversely affecting the plants to be protected or significantly altering the environmental conditions of the soil and the surroundings into which these fungicides are introduced.

In accordance with the present invention a new 10 class of compounds having the structural formula



where R and R¹ are the same or different and are hydrogen or C₁-C₆ alkyl; R² is hydrogen, chlorine or bromine; R³ is 20 hydrogen, C₁-C₆ alkyl, C₁-C₆ alkoxy, halogen, trihalomethyl, nitro, cyano, phenyl, phenyl substituted with C₁-C₄ alkyl, C₁-C₄ alkoxy, halogen, trihalomethyl, nitro, cyano, phenoxy or phenoxy substituted with C₁-C₄ alkyl, C₁-C₄ alkoxy, halogen, trihalomethyl, nitro or cyano; and n is 0 or 1 is 25 disclosed.

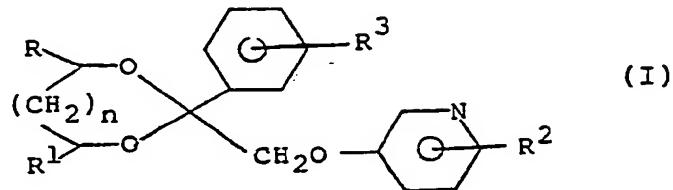
In addition, a composition comprising a fungicidally effective amount of the compound of this invention and a carrier therefor is set forth.

Finally, the present invention is also directed to 30 a process for controlling phytopathogenic fungi which comprises applying a fungicidally effective amount of the compound of this invention to the locus to be protected.

1 DETAILED DESCRIPTION

The compounds of the present invention have the structural formula

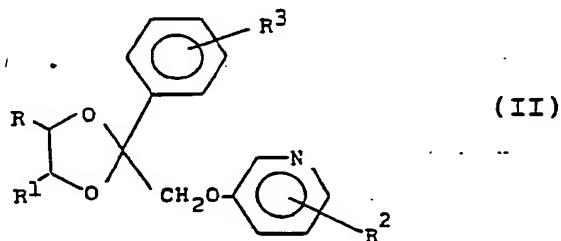
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- 10 where R and R¹ are the same or different and are hydrogen or C₁-C₆ alkyl; R² is hydrogen, chlorine or bromine; R³ is hydrogen, C₁-C₆ alkyl, C₁-C₆ alkoxy, halogen, trihalomethyl, nitro, cyano, phenyl, phenyl substituted with C₁-C₄ alkyl, -C₁-C₄ alkoxy, halogen, trihalomethyl, nitro or cyano, phenoxy or phenoxy substituted with C₁-C₄ alkyl, C₁-C₄ alkoxy, halogen, trihalomethyl, nitro or cyano; and n is 0 or 1.
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- It is emphasized that the compound having the structural formula I encompasses dioxolanes, which correspond to the compound having the structural formula I where n is 0.
- 20 The dioxolane compounds within the contemplation of the present invention have the structural formula

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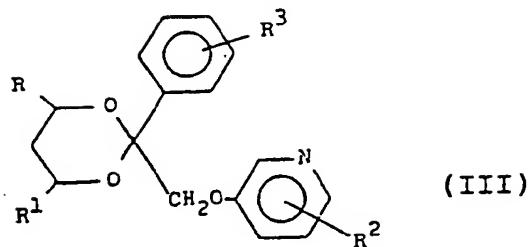
- 30 where R, R¹, R² and R³ have the meanings given for the compound having the structural formula I.

- The equally preferred dioxanes, within the contemplation of the present invention, are defined by the compound having the structural formula I where n is 1. The 35 dioxanes of the present application have the structural formula

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where R, R¹, R² and R³ have the meanings given for the compound having the structural formula I.

The present invention also encompasses salts of the compound having the structural formula I. Salts within the contemplation of the subject invention are preferably addition products of the compound having the structural formula I, as well as compounds of structural formulae II and III within the genus of the compound having the structural formula I, and various acids. Among the preferred acids, which may be employed to produce salts of the present invention, are such inorganic acids as hydrochloric, hydrobromic, nitric and sulfuric acids. Organic acids, which also may be employed in the formation of salts within the contemplation of the present invention, include the sulfonic acids, methanesulfonic acid and p-toluenesulfonic acid. Of these acids, hydrochloric acid and methanesulfonic acid are particularly preferred in producing the salts of the subject invention.

A careful review of the structural formula I makes apparent to those skilled in the art that when R and R¹ are different, the carbon atom at the 2-position is asymmetrical. As such, this gives rise to optical isomers. Furthermore, in the case where either R or R¹ are not hydrogen, compounds having the structural formula I, or the subgeneric structural formulae II or III, may exist as geometric isomers in that R or R¹ are cis or trans relative to the substituents at the 2-position of the dioxolane or dioxane ring. It should therefore be appreciated that isomers, as well as mixtures of isomers, of the sort discussed above, are within the contemplation of the present invention.

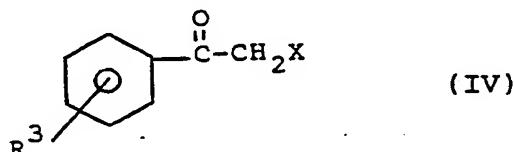
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1 Preferably, compounds having the structural formula I are characterized by R and R¹ being the same or different and being hydrogen or C₁-C₄ alkyl; R² being hydrogen or chlorine; R³ being hydrogen, halogen, phenyl or phenoxy
 5 substituted with methyl, ethoxy, halogen or trifluoromethyl; and n is 0 or 1.

More preferably, the compound having the structural formula I is defined by R and R¹ being hydrogen or C₁-C₃ alkyl; R² being hydrogen, R³ being chlorine, phenyl, or
 10 phenoxy substituted with halogen or trifluoromethyl; and n is 0 or 1. The latter definition, in the more preferred definition of the compound of the present invention, the definition of n being 0 or 1, emphasizes that no preference should be given over each other to the compounds having the
 15 structural formulae II and III.

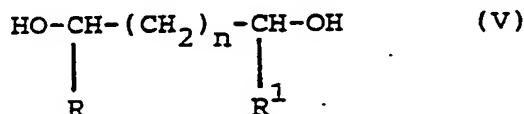
The compound having the structural formula I is prepared in a two-step process wherein an alpha-haloketone having the structural formula

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where X is halogen, preferably, bromine; and R³ has the meanings given in the definition of structural formula I, is subjected to cyclization by reaction with a diol having the structural formula

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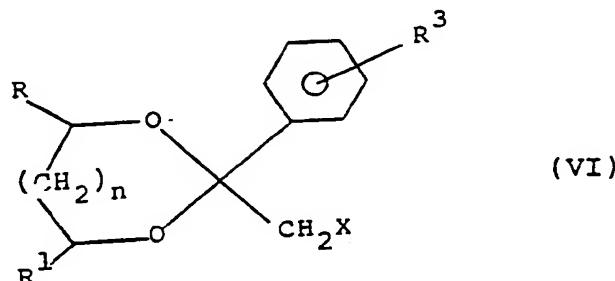
where R, R¹ and n have the meanings given in defining structural formula I.

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1 The product of this cyclization reaction is a
2-halomethyl ketal having the structural formula

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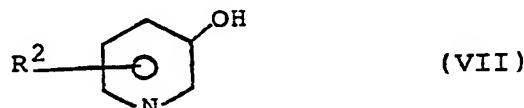
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where R, R¹, R³, X and n have the meanings given above. It is emphasized that details of this type of reaction are known in the art. For example, Synthesis, 1, 23, (1974) provides specifics of this reaction. The above referenced article is incorporated herein by reference.

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The 2-halomethyl ketal compound having the structural formula VI is reacted with a 3-hydroxypyridine compound having the structural formula

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where R² has the same meanings as given for that substituent in structural formula I. This reaction occurs in the presence of an acid acceptor, preferably potassium carbonate. Moreover, the 3-hydroxypyridine compound having the structural formula VII is introduced into the reaction as a solution in which the solvent is preferably N,N-dimethylacetamide. The reaction usually occurs by refluxing the compounds having the structural formulae VI and VII at the boiling temperature of the solvent, usually N,N-dimethylacetamide, for a period of between about 6 hours and about 72 hours, preferably about 18 hours. The product of this reaction is the compound having the structural formula I.

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1 Another aspect of the present invention is a
composition which comprises a fungicidally effective amount
of the compound having the structural formula I and a carrier
therefor. Carriers within the contemplation of the
5 composition of this invention may be liquids, solids or
mixtures thereof.

10 Turning first to liquid carriers useful in
producing the composition of the present invention, the
liquid carrier may be a solvent or a dispersant. In
addition, two liquid carriers can be utilized, one
15 serving as a solvent and the other as a dispersant.

15 In the preferred embodiment wherein the composition
is a solution, the solvent carrier is usually an organic
compound which may be polar or non-polar. Solvents within
the contemplation of the composition of this invention
include acetone, methanol, isopropanol, t-butyl alcohol,
cyclohexanone, n-butyl alcohol, toluene, xylene, dioxane,
dimethylformamide, dimethylsulfoxide, ethylene dichloride and
N-methylpyrrolidone.

20 Another class of liquid compositions within the
contemplation of this invention is emulsions. An emulsion is
formed when the compound having the structural formula I is
dispersed in water in the presence of a surface active agent.
An emulsion is preferably formed by first preparing a
25 solution of the type discussed in the above paragraph. The
solution is then dispersed in water and a surface active
agent added thereto to form the emulsion. Surface active
agents suitable for use in forming an emulsion within the
contemplation of the composition of this invention are known
30 to those skilled in the art. McCutcheon's Detergents and
Emulsifiers, Allured Publishing Corp., Ridgewood, NJ (1970);
U.S. Patent 2,514,916 and U.S. Patent 2,547,734 provide
examples of surface active agents useful in forming emulsions

1 within the contemplation of the composition of this
invention. The above recited references are incorporated
herein by reference. As set forth in these references, the
surface active agents may be anionic, cationic or non-ionic.

5 A third class of liquid compositions within the
scope of this invention utilize a liquid dispersant as the
carrier. In this embodiment, the compound having the
structural formula I is dispersed in water in the absence of
a surface active agent. Alternatively, the liquid
10 composition involves a solution of the compound having the
structural formula I, which, in turn, is dispersed in water,
again in the absence of a surface action agent.

15 Yet another class of liquid compositions within the
scope of the present invention utilizes an aerosol. An
aerosol is liquid under pressure but is gaseous at
atmospheric pressure and ambient temperature. In most
instances an aerosol composition is prepared by first forming
20 a solution of the compound having the structural formula I in
a conventional solvent of the type discussed above. This
solution is admixed with a volatile liquid aerosol under
pressure in which condition the composition is applied.

25 A second major class of composition within the
meaning of the present invention are solid compositions which
employ a solid carrier. Solid carriers useful in the
formation of the composition of this invention include dusts,
granules, wettable powders, pastes and water soluble solids.
For example, compositions within the contemplation of this
30 invention may be applied as a dust when adsorbed or absorbed
onto or mixed with a powdered, solid carrier. A solid
carrier such as a mineral silicate, e.g., mica, talc,
pyrophyllite and clays, may be utilized for this purpose.

1 Additional solid compositions can be prepared from
granular formulations of the compound having the structural
formula I and a granular or pelletized form of carrier such
as granular clay, vermiculite, charcoal, corncobs or the
5 like. The use of granular formulations is particularly
suitable for application by broadcasting, side-dressing, soil
incorporation or seed treatment.

A mixture of a solid and liquid composition, that
employs both a liquid and a solid carrier, may also be used.
10 Such a composition, for example, is prepared by dispersing a
solid, on which the compound having the structural formula I
is absorbed or adsorbed, in a liquid dispersant. Such a
composition preferably includes a surface active agent to
maintain the solid particles dispersed in the liquid
15 dispersant.

It should be emphasized that the composition of the
present invention may utilize a carrier which is itself
active. That is, the carrier may be a plant growth regulant,
an insecticide, an acaricide, a fungicide, a bacteriacide or
20 the like.

The concentration of the compound having the
structural formula I in the composition of this invention is
a fungicidally effective amount. The exact concentration of
a fungicidally effective amount depends upon such factors as
25 the specific plant, or plants, which is to be protected, the
fungus, or the fungi, which is to be controlled, soil
conditions and chemistry and the climatic conditions under
which the plant is grown. Generally, the concentration of
Compound I, which is representative of a fungicidally
30 effective amount, in the composition of the present invention
may range from about 0.1% to about 95% by weight. However,
when the compound having the structural formula I is applied

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1 as a spray, the dilution may be very high, resulting in a
concentration as low as a few parts per million parts of
composition. On the other hand, when ultra-low volume
applications are employed, full strength concentrates may be
5 utilized.

The present invention is also concerned with a process for controlling phytopathogenic fungi. In this process the compound having the structural formula I is applied to the locus under attack by said fungi in a
10 fungicidally effective concentration.

In one preferred embodiment of the process of this invention the compound having the structural formula I is applied to the foliage of the plant or plants to be protected. This so-called "foliar treatment" is effectuated
15 by applying the compound having the structural formula I to foliage at a concentration of between about 10 milligrams and about 500 milligrams of the compound per liter of inert liquid carrier.

In another preferred embodiment of the process of
20 the present application, the process of controlling phytopathogenic fungi, a fungicidally effective amount of the compound having the structural formula I is applied to the soil in which the plant, or plants, to be protected from fungi is grown. In this method, the so-called "systemic treatment," the compound having the structural formula I is applied to the soil in a concentration of between about 0.125 and about 10 kilograms of compound per hectare of soil in
25 which the plant, or plants, to be protected is grown. More preferably, systemic control involves application of between about 0.125 kg/ha and about 5 kg/ha of the compound having the structural formula I to the soil in which the plant, or
30 plants, to be protected is grown.

1 Independent of which preferred process of
controlling fungi is utilized, the application may be applied
prior to or after infection by fungi. Furthermore, it should
be appreciated that the exact dosage, applied systemically or
5 directly to foliage, is dictated by the fungus to be
controlled and the particular plant to be protected.

In another embodiment of the process of controlling
phytopathogenic fungi utilizing the compound of the present
invention, the compound having the structural formula I, the
10 compound is applied as a coating to seeds of the plant to be
protected. This embodiment of the process of the present
invention provides the benefits of the two preferred
embodiments discussed above, foliage treatment and systemic
treatment. That is, the fungicidal coating, the coating of
15 the compound having the structural formula I, protects the
soil from infection by the fungi but is also taken up by the
plants systemically to protect the plant from fungal attack.
In this so-called "seed coating method," a concentration of
the compound having the structural formula I in the range of
20 between about 5 and about 75 grams per 100 kg. of seed is
usually utilized.

The following examples are given to illustrate the
scope of the present invention. Because these examples are
given for illustrative purposes only, the scope of the
instant invention should not be limited thereto.
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EXAMPLE 1

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Preparation of 3-[[2-([1,1'-Biphenyl]-4-yl)-1,3-dioxolan-2-yl]methoxy]pyridine (Compound No. 2)

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A mixture of 2-([1,1'-biphenyl]-4-yl)-2-(bromo-methyl)-1,3-dioxolane (16 g.), 3-hydroxypyridine (5.7 g.) and potassium carbonate (9 g.) were refluxed with stirring in N,N-dimethylacetamide (75 ml.) for 18 hours. After refluxing, the mixture was allowed to cool and was thereafter poured into water (150 ml.). The resultant aqueous solution was extracted twice with ether. The combined ether fractions were washed once with 5% aqueous sodium hydroxide and 4 times with water. The washed ether fractions were then dried, filtered and the solvent evaporated to yield 3-[[2-([1,1'-biphenyl]-4-yl)-1,3-dioxolan-2-yl]methoxy]pyridine as an oil.

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EXAMPLE 2Preparation of 3-[2-([1,1'-Biphenyl]-4-yl)-1,3-dioxolan-2-yl]methoxy]pyridine hydrochloride (Compound No. 1)

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The compound of Example 1, 3-[2-([1,1'-biphenyl]-4-yl)-1,3-dioxolan-2-yl]methoxy]pyridine (3 g.) was formed into a solution by being dissolved in dry ether (250 ml.).

10 The solution was cooled in an ice bath and dry hydrogen chloride gas was bubbled into the solution. This resulted in precipitation. When precipitation was ended, the solid was isolated by filtration and crushed to give a fine powder. The powder was identified as the titled compound having a melting point of 191°C to 193°C.

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EXAMPLE 3

Preparation of 3-[[2-(4-Bromophenyl)-1,3-dioxolan-2-yl]-methoxy]pyridine methanesulfonate (Compound No. 7)

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A mixture of 2-(bromomethyl)-2-(4-bromophenyl)-1,3-dioxolane (25.5 g.), 3-hydroxypyridine (9.0 g.) and potassium carbonate (14.2 g.) in N,N-dimethylacetamide (125 ml.) was refluxed for 18 hours with stirring. Upon completion of this
10 refluxing the mixture was allowed to cool. To this cooled reaction mixture was added water (250 ml.) and extracted with two portions of ether. The combined ether fractions were washed once with 5% aqueous sodium hydroxide and four times with water. The resulting ether layer was dried, filtered
15 and evaporated resulting in the formation of an oil (18.5 g.).

A solution of this oil (3 g.) in dry ether was prepared and cooled in an ice bath. To this cooled solution was added methanesulfonic acid (0.9 g.) by dropwise addition accompanied by stirring. The resulting precipitate was
20 obtained by filtration. After drying, the product, having a melting point of 133°C to 134°C, was identified as 3-[[2-(4-bromophenyl)-1,3-dioxolan-2-yl]methoxy]pyridine methanesulfonate.

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EXAMPLE 4Preparation of 3-[[2-([1,1'-biphenyl]-4-yl)-4,5-dimethyl-1,3-dioxolan-2-yl]methoxy]pyridine (Compound No. 15)

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A mixture of 2-([1,1'-biphenyl]-4-yl-2-(bromo-méthyl)-1,3-dioxolane (10 g.), 3-hydroxypyridine (4.7 g.) and potassium carbonate (5.2 g.) was refluxed with stirring for 18 hours. At the completion of this period, the mixture was cooled to ambient temperature. Water (250 ml.) was added to the cooled mixture and extracted with toluene. The resultant toluene solution was washed with water, then dried, filtered and evaporated to yield 3-[[2-([1,1'-biphenyl]-4-yl)-4,5-dimethyl-1,3-dioxolan-2-yl]methoxy]pyridine as an oil.

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EXAMPLE 5

Preparation of 3-[[2-(2,4-Dichlorophenyl)-4-methyl-1,3-dioxolan-2-yl]methoxy]pyridine (Compound No. 18)

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A mixture of 2-(bromophenyl)-2-(2,4-dichlorophenyl)-4-methyl-1,3-dioxolane (10 g.), 3-hydroxypyridine (3.8 g.) and potassium carbonate (5.5 g.) in N,N-dimethylacetamide (90 ml.) was refluxed with stirring for 18 hours. After the mixture was allowed to cool, it was poured into water and extracted with toluene. The toluene fraction, thereby obtained, was washed with 5% aqueous sodium hydroxide and evaporated to yield 3-[[2-(2,4-dichlorophenyl)-4-methyl-1,3-dioxolan-2-yl]methoxy]pyridine as an oil.

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EXAMPLE 6

Preparation of 3-[[2-[4-[3-(Trifluoromethyl)phenoxy]phenyl]-1,3-dioxolan-2-yl]methoxy]pyridine hydrochloride
(Compound No. 22)

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A mixture of 2-(bromomethyl)-2-[4-[3-(trifluoromethyl)phenoxy]phenyl]-1,3-dioxolane (8 g.), 3-hydroxypyridine (2.4 g.) and potassium carbonate (3.5 g.) in
10 N,N-dimethylacetamide (40 ml.) was refluxed for 18 hours with stirring. The reaction mixture was allowed to cool, poured into water and extracted twice with toluene. The combined toluene fractions were washed once with 5% aqueous sodium hydroxide and three times with water. The toluene fraction
15 was then dried, filtered and evaporated to yield an oil (5.3 g.).

A portion of the thus obtained oil (2 g.) was dissolved in ether and dry hydrogen chloride gas was bubbled into the solution. This resulted in material oiling out of the solution. The material oiled out of the solution was
20 cooled resulting in the solidification of the oil. This solid was isolated by filtration and identified as 3-[[2-[4-[3-(trifluoromethyl)phenoxy]phenyl]-1,3-dioxolan-2-yl]methoxy]pyridine hydrochloride. This product was obtained as a gray powder and was identified by its melting point of
25 138°C to 140°C.

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EXAMPLE 7

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Preparation of Compounds Nos. 3-6, 8-14, 16, 17, 19-21
and 23-29

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Compound Nos. 3-6, 8-14, 16, 17, 19-21 and 23-29 were prepared in accordance with the procedure used in Examples 1 to 6. They resulted in the formation of compounds whose identity is summarized in Table I. Table I identifies not only the compounds of this example but also the compounds synthesized in Examples 1 to 6. These compounds, Compound Nos. 1 to 29, are identified by their structural formula wherein the substituents are defined in Table I. Those compounds which are salts are further defined by the identity of the acid which is employed to form the salt. In addition, those compounds which are solid at ambient conditions are defined by their melting point. Table II identifies those compounds listed in Table I as being an oil at ambient conditions by their nuclear magnetic resonance spectroscopy data.

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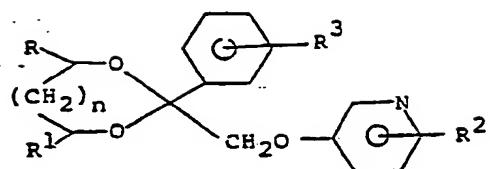
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TABLE I

Cpd. No.	n	R	<u>R</u> ¹	<u>R</u> ²	<u>R</u> ³	Salt	MP (°C)
1	0	H	H	H	4-Ph	HCl	191-193
2	0	H	H	H	4-Ph		Oil
3	0	H	H	H	2,4-Cl ₂		Oil
4	0	H	H	H	4-Br		Oil
5	0	H	H	H	2-Cl		Oil
6	0	H	H	H	4-CH ₃	CH ₃ SO ₃ H	104-106
7	0	H	H	H	4-Br	CH ₃ SO ₃ H	133-134
8	0	H	H	H	4-C(CH ₃) ₃	HCl	134-137
9	0	CH ₃ CH ₂ CH ₂	H	H	H		Oil
10	0	CH ₃ CH ₂	H	H	H		Oil
11	0	CH ₃	CH ₃	H	H		Oil
12	0	CH ₃	H	H	4-Ph		Oil
13	0	CH ₃	H	H	4-Cl		Oil
14	0	CH ₃	H	H	2-Cl		Oil
15	0	CH ₃	CH ₃	H	4-Ph		Oil
16	0	H	H	H	4-F	HCl	168-172
17	0	CH ₃ CH ₂	H	H	4-Ph		Oil
18	0	CH ₃	H	H	2,4-Cl ₂		Oil
19	0	CH ₃ CH ₂	H	H	2,4-Cl ₂		Oil
20	0	H	H	H	4-(4-CH ₃ OPh)		Oil
21	0	H	H	H	4-(3-CF ₃ OPh)		Oil
22	0	H	H	H	4-(3-CF ₃ OPh)	HCl	138-140
23	0	CH ₃	H	H	4-(3-CF ₃ OPh)		Oil

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TABLE I (Cont'd.)

Cpd. No.	n	R	<u>R</u> ¹	<u>R</u> ²	<u>R</u> ³	Salt	MP(°C)
24	0	CH ₃	H	H	4-(2,4-Cl ₂ OPh)		Oil
25	0	H	H	H	4-(2-CH ₃ CH ₂ OOPh)		Oil
26	0	H	H	2-Br	4-(4-FOPh)	HCl	73-78
27	0	H	H	2-Cl	4-(4-BrOPh)		Oil
28	0	H	H	2-Cl	4-(4-ClOPh)		Oil
29	1	H	H	5-Cl	2,4-Cl ₂	HCl	128-129

Remarks:

Ph is phenyl

OPh is phenoxy

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TABLE II

<u>Cpd No.</u>	<u>NMR data (δ) for CDCl₃</u>
2	8.1-8.4(m, 2H), 7.0-7.7(m, 11H), 4.3(s, 2H), 3.7-4.3(m, 4H)
3	8.1-8.4(m, 2H), 7.7(d, 1H), 7.0-7.5(m, 4H), 4.4(s, 2H), 3.7-4.3(m, 4H)
4	8.1-8.3(m, 2H), 7.4(s, 4H), 7.1-7.3(m, 2H), 4.2(s, 2H), 3.8-4.2(m, 4H)
5	8.1-8.4(m, 2H), 7.7-7.9(m, 1H), 7.1-7.4(m, 5H), 4.5(s, 2H) 3.8-4.3(m, 4H)
9	8.1-8.4(m, 2H), 7.1-7.7 (m, 7H), 4.2(s+s, 2H), 3.4-4.3(m, 3H), 0.8-1.8(m, 7H)
10	8.1-8.4(m, 2H), 7.1-7.7(m, 7H), 4.2(s+s, 2H), 3.4-4.4 (m, 3H), 1.3-1.8(m, 2H), 0.8-1.2(m, 3H)
11	8.1-8.4(m, 2H), 7.1-7.7(m, 7H), 4.2(s, 2H), 3.4-4.1(m, 2H), 2.3(d, 3H), 1.2(d, 3H)
12	8.1-8.5(m, 2H), 7.1-7.7(m, 11H), 4.2(s+s, 2H), 3.5-4.2(m, 3H), 1.3(d+d, 3H)
13	8.1-8.4(m, 2H), 7.1-7.7(m, 6H), 4.2(s+s, 2H), 3.5-4.6 (m, 3H), 1.3(d+d, 3H)
14	8.1-8.4(m, 2H), 7.1-7.9(m, 6H), 4.5(s+s, 2H), 3.4-4.5(m, 3H), 1.3(d+d, 3H)

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TABLE II (Cont'd.)

<u>Cpd. No.</u>	<u>NMR data (δ) for CDCl₃</u>
15	8.1-8.4(m, 2H), 7.2-7.7(m, 11H), 4.2(s, 2H), 3.5-4.1(m, 2H), 1.4(d, 3H), 1.2(d, 3H)
17	8.0-8.6(m, 2H), 7.1-7.7(m, 11H), 4.2(s+s, 2H), 3.5-4.3(m, 3H), 1.3-2.0(m, 2H), 0.8-1.2(m, 3H)
18	8.1-8.3(m, 2H), 7.5-7.8(m, 1H), 7.1-7.4(m, 4H), 4.4(s+s, 2H), 3.3-4.4(m, 3H), 1.3(d+d, 3H)
19	8.1-8.3(m, 2H), 7.5-7.8(m, 1H), 7.1-7.5(m, 4H), 4.4(s+s, 2H), 3.4-4.3(m, 3H), 1.3-1.9(m, 2H), 0.8-1.2(m, 3H)
20	6.8-7.7(m, 12H), 4.3(s, 2H), 3.7-4.3(m, 4H), 2.3(s, 3H)
21	8.0-8.7(m, 2H), 6.9-7.8(m, 10H), 4.3(s, 2H), 3.8-4.4(m, 4H)
23	8.1-8.4(m, 2H), 6.9-7.7(m, 10H), 4.2(s+s, 2H), 3.5-4.6(m, 3H), 1.3(d+d, 3H)
24	8.0-8.6(m, 2H), 6.8-7.7(m, 9H), 3.5-4.5(m, 6H), 1.3(d+d, 3H)
25	8.1-8.4(m, 2H), 6.8-7.6(m, 10H), 4.2(s, 2H), 3.9(q, 2H), 3.8-4.2(m, 4H), 1.2(t, 3H)
27	7.9-8.1(m, 1H), 6.8-7.7(m, 9H), 4.2(s, 2H), 3.9-4.3(m, 4H)
28	7.8-8.0(m, 1H), 6.8-7.7(m, 9H), 4.2(s, 2H), 3.8-4.4(m, 4H)

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EXAMPLE 8

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Preparation of Fungicidal Compositions

Each of Compound Nos. 1 to 24 (0.3 g.), summarized
5 in Table I, were dissolved in acetone (10 ml.): Water and
one or two drops of the emulsifying agent, Triton [trademark]
X-100 were added to the thus formed solution to form an
emulsion. The amount of water added was a function of the
desired concentration of the emulsion composition which are
10 hereinafter reported as milligrams per liter (mg/l).

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EXAMPLE 9

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Control of Powdery Mildew Fungus by Systemic Root Uptake

5 Compositions of Compound Nos. 1 to 29, formed in accordance with the procedure of Example 8, were tested to evaluate their effectiveness in preventing or controlling powdery mildew disease of barley caused by the fungus, Erysiphe graminis and powdery mildew disease of cucumber 10 caused by the fungus, Erysiphe cichoracearum. This prevention or control capability, utilizing the compounds of the present invention, was tested using the systemic root uptake method of applying the fungicidal compositions to the plants to be protected.

In accordance with the aim of this test, pots 15 (4 x 4 x 3.5 inches) containing ten plants of barley (Variety "Herta") or ten plants of cucumber (Variety "Marketmore 70") were grown to an age of six days and ten days, respectively. Upon reaching these ages, emulsion compositions (45 ml.) of 20 Compound Nos. 1 to 29, formed in accordance with the procedure of Example 8, were added to each pot. That is, emulsion compositions (45 ml.) of each of the compounds of Table I was separately added to pots containing ten barley or ten cucumber plants of the type enumerated above. The 25 emulsion compositions saturated the soil in each pot without significant loss through drainage into saucers below the pots. Each of the compositions contained one of Compound Nos. 1 to 29 in a concentration of 250 mg/l. A number of 30 pots containing the barley and cucumber plants which were treated with the compounds of this invention were left untreated as controls.

The barley and cucumber plants in all the pots, including those treated and those untreated, were inoculated with powdery mildew fungus 24 hours after treatment with the emulsion compositions containing Compound Nos. 1 to 29.

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1 Fungus inoculation was accomplished by tapping leaves of
previously infected barley and cucumber plants over the
treated and untreated pots containing the barley and cucumber
plants, respectively, to distribute the spores of the fungus
over the plants growing in the pots.

5 Six days after inoculation, disease control was
evaluated on a 0 to 6 rating scale. A 0 rating was assigned
when no disease was evidenced on the plant. A 6 rating was
given for severe disease. Intermediate ratings were assigned
10 depending on the degree of disease. Percent control was
computed by comparing the ratings of the treated and
untreated plants.

15 The results of this test are reported in Table III,
wherein systemic control of powdery mildew disease in barley
is reported under the title "BMS 250." Control of powdery
mildew disease in cucumber is reported under the title "CMS
250."

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EXAMPLE 10

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Control of Powdery Mildew Fungus by Foliar Application

A large number of planting pots, identical with
5 those utilized in Example 9, sufficient to accommodate
testing in duplicate or triplicate for each of the 29
compounds tabulated in Table I, were each planted with eight
barley plants (Variety "Larker"). There were enough planted
pots so that for each treated pot there was at least one pot
10 untreated which acted as a control.

Each of the treated pots were sprayed with
emulsions of each of Compound Nos. 1 to 29 in a concentration
of 1000 milligrams of the compound per liter of water (1'000
mg/l). After the foliage of the sprayed barley plants were
15 dried, all the plants, including the unsprayed control
plants, were placed in a greenhouse maintained at 21°C. All
the plants, controls as well as sprayed plants, were
thereupon inoculated with powdery mildew fungus, Erysiphe
20 graminis. Inoculation of the fungus was accomplished in
accordance with the method utilized in Example 9.

Five days after inoculation, the plants were
evaluated and assigned a disease rating of 0 to 6 in
accordance with the criteria explained in Example 9.
Percentage control was computed in accordance with the method
25 utilized in Example 9. The results of this test are
summarized in Table III under the title "BMP 1000."

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EXAMPLE 11

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Bean Rust Fungus Eradicant and Bean Powdery
Mildew Protectant Test

15 Two pinto bean plants, *P. vulgaris*, were planted in a plurality of pots. When the plants were seven days old, at the primary leaf stage of growth, they were all sprayed with a suspension containing 20,000 spores of the bean rust fungus, *Uromyces phaseoli*, per milliliter of suspending water. All the pots containing the inoculated plants were 20 than incubated in a controlled environmental chamber, maintained at 99% humidity and 21°C, for 24 hours to allow infection to develop. The plants were then moved from the incubator and allowed to dry.

25 Two days after inoculation the infected plants were separately sprayed with each of the emulsion compositions containing Compound Nos. 1 to 29, tabulated in Table I, prepared in accordance with the procedure of Example 8. Each of the emulsion compositions provided a dosage of 1,000 mg/l of the active compound. An equal number of infected 30 plants, not sprayed, acted as controls. All the sprayed and unsprayed plants were placed in a greenhouse, maintained at a temperature of 21°C for five days to allow any disease to be expressed. The treated plants were additionally tested for bean powdery mildew protectant use by inoculating all 35 plants by tapping spores of *Erysiphe polygoni* mildew over the leaves.

The sprayed and unsprayed control plants were examined for disease which was assessed using the 0 to 6 rating system described in Example 9. Disease control, as 40 explained in Example 9, was then determined. The control of disease, expressed as percent reduction of disease, is included in Table III under the titles "BRE 1000 and PMP 1000."

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EXAMPLE 12

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Control of Barley Blast by Foliar Treatment

5 A plurality of planting pots which included ten plants of six day old barley (Variety "Herta") were prepared. These pots were sprayed with the emulsion compositions, prepared in accordance with the procedure of Example 8, of each of Compound Nos. 1 to 29, set forth in Table I.

10 The plants in these pots, as well as an equal number of six day old Variety "Herta" barley plants in control pots, were inoculated with spores of the blast fungus, Pyricularia oryzae. The method of inoculation was identical with that utilized in Example 9.

15 All the fungus inoculated plants were placed in a greenhouse, maintained at a temperature of 21°C and a humidity of 99%, for five days. At that time, the plants were evaluated on the 0 to 6 disease rating system, explained in Example 9. Percent control was computed by comparing the 20 ratings of the sprayed and unsprayed plants. The results of this test are included in Table III under the title "BBL 1000."

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EXAMPLE 13Control of Nine Fungus Species

5 - Each of the compounds included in Table I, Compound Nos. 1 to 29, were solubilized in acetone at a concentration of 500 mg/l. Filter paper discs, each 11 mm. in diameter, were immersed in each of the thus formed solutions. The discs were allowed to dry in air, thus driving off the 10 acetone solvent. An equal number of discs were not immersed in these solutions and acted as controls.

Each of the treated and untreated disks were then placed in agar plates and the fungus species, Alternaria solani, was added to the center of each paper disc in the 15 form of a culture plug with the fungus mat in contact with the treated paper of the test disc or, in the case of the controls, in contact with the untreated filter test disc. The agar plates were incubated at 29°C in an oven.

Upon removal from the oven, percent growth 20 inhibition by the compounds of the fungus species was evaluated by measuring the radius from the center of the fungus colony of the treated discs compared to the radius from the center of the fungus colony of the untreated disks. That is, inhibition effectuated by each of the compounds was 25 determined as a function of the percent difference between the radii of the treated and untreated discs. The results of these tests appear in Table III under the title "ALT 500."

In a similar fashion, the fungus species: Botrytis cinerea, Fusarium oxysporum, Helminthosporium maydis, 30 Phytophthora infestans, Sclerotinia sclerotiorum and Sclerotium rolfsii were treated in exact accordance with the procedure utilized to test the fungus species, Alternaria solani. The effectiveness of Compound Nos. 1 to 29, in

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controlling these six fungus species are summarized in Table
III under the titles "BOT 400," "FUS 500," "HMY 500," "PHY
500," "SCM 500" and "SCO 500." These designations refer to
10 the six fungus species in the order of their earlier
recitation in the discussion of this example.

A separate test was utilized to determine the control
of a ninth fungus species, Cercospora arachidicola. This
species was tested by depositing two drops of a spore
15 suspension of the fungus (20,000 spores per millimeter) to
the above-discussed chemically treated discs rather than as
a mycelial cell culture plug. Scoring of the effectiveness
of the compounds in controlling the Cercospora arachidicola
fungus was accomplished without the use of a control. A
20 rating of 100 represented complete inhibition of germination
and growth of the fungus; a rating of 80 represented nearly
complete inhibition but some growth of the fungus; a rating
of 50 represented partial inhibition but some growth or
early complete inhibition with later growth; a rating 20
25 indicated some, but not significant, inhibition of growth;
and a 0 rating indicated complete growth of the fungus
without any inhibition. The rating of this species is
included in Table III under the title "CER 500."

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TABLE IIIPercent Fungicidal Control

Cpd. No.	ALT 500	BBL 1000	BMP 1000	BMS 250	BOT 500	BRE 1000	CER 500	CMS 250	FUS 500	HMY 500	PHY 500	PMP 1000	SCH 500	SCO 500
1	25	90	90	0	0	0	0	0	0	0	45	0	0	10
2	0	90	90	0	0	0	0	15	15	40	76	0	0	40
3	0	50	100	0	0	0	0	15	15	15	75	0	15	0
4	0	0	20	0	35	0	0	50	50	0	50	95	0	0
5	0	0	0	40	35	0	0	0	20	10	50	95	0	35
6	0	0	90	0	35	0	0	0	0	15	0	0	0	0
7	0	20	90	0	0	0	0	0	0	0	20	0	30	0
8	0	0	90	0	15	0	0	0	0	0	0	0	50	0
9	10	90	90	35	50	0	0	0	0	35	0	0	0	25
10	35	80	90	15	25	0	0	0	0	0	0	0	0	35
11	10	80	90	35	0	0	0	50	10	35	0	0	0	0
12	25	80	100	35	0	0	0	0	0	45	15	95	55	0
13	15	40	100	35	0	0	0	50	40	15	20	50	0	0
14	50	80	90	35	0	0	0	0	10	25	35	90	0	35
15	55	90	90	15	50	0	0	0	30	35	0	90	0	35
16	0	80	100	97	0	20	0	45	0	25	35	0	0	0
17	35	50	90	0	0	0	0	0	0	60	35	0	0	0
18	40	0	90	0	0	75	0	0	0	0	60	80	0	30
19	25	15	90	0	0	25	0	0	0	0	0	90	0	0
20	10	15	85	60	55	0	0	0	0	10	15	0	60	35
21	0	65	90	0	70	0	0	0	0	0	0	0	0	0
22	0	50	90	0	100	0	0	0	0	20	50	0	0	25
23	0	15	90	0	0	0	0	0	0	10	0	0	0	0
24	0	85	85	0	0	0	0	0	0	35	0	0	0	0
25	40	90	100	0	0	0	0	0	0	0	0	70	0	0
26	40	100	0	15	0	0	0	0	0	0	0	0	0	0
27	20	85	75	10	0	0	0	0	0	0	0	0	0	0
28	30	90	35	0	10	0	0	0	10	25	15	0	10	0
29	0	0	100	15	30	0	0	50	5	45	5	0	5	55

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1 The above embodiments and examples are given to
illustrate the scope and spirit of the instant invention.
These embodiments and examples will make apparent, to those
skilled in the art, other embodiments and examples. These
5 other embodiments and examples are within the contemplation
of the present invention. Therefore, this invention should
be limited only by the appended claims.

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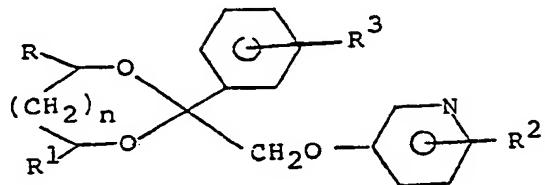
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1 WHAT IS CLAIMED IS:

1. A compound having the structural formula

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10 where R and R¹ are the same or different and are hydrogen or C₁-C₆ alkyl; R² is hydrogen, chlorine or bromine; R³ is hydrogen, C₁-C₆ alkyl, C₁-C₆ alkoxy, halogen, trihalomethyl, nitro, cyano, phenyl, phenyl substituted with C₁-C₄ alkyl, C₁-C₄ alkoxy, halogen, trihalomethyl, nitro or cyano, phenoxy or phenoxy substituted with C₁-C₄ alkyl, C₁-C₄ alkoxy, halogen, trihalomethyl, nitro or cyano; and n is 0 or 1.

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20 2. A compound in accordance with Claim 1 wherein R and R¹ are the same or different and are hydrogen or C₁-C₄ alkyl; R² is hydrogen or chlorine; R³ is hydrogen, halogen, phenyl or phenyl substituted with methyl, ethoxy, halogen or trifluoromethyl.

25 3. A compound in accordance with Claim 2 where R and R¹ are the same or different and are hydrogen or C₁-C₃ alkyl; R² is hydrogen; R³ is chlorine, phenyl or phenoxy substituted with halogen or trifluoromethyl.

30 4. A salt comprising the product of the compound of Claim 1 and an organic or inorganic acid.

5. A salt in accordance with Claim 4 wherein said acid is hydrochloride acid or methanesulfonic acid.

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1 6. A composition comprising a fungicidally
effective amount of the compound of Claim 1 and a carrier
therefor.

3 5 7. A composition comprising a fungicidally
effective amount of the salt of Claim 4 and a carrier
therefor.

10 8. A process for controlling phytopathogenic fungi
comprising applying a fungicidally effective amount of the
compound of Claim 1 to the locus under attack by phytopatho-
genic fungi.

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INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 91/07801

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.C1.. 5 C07D405/12; A01N43/40; // (C07D405/12; 319:00; 213:00)
(C07D405/12; 317:00; 213:00)

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

Classification System	Classification Symbols
Int.C1. 5	C07D

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched⁸III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	EP,A,0 129 507 (CIBA-GEIGY AG) 27 December 1984 see claims 1,10-14; tables ---	1-8
A	EP,A,0 122 410 (CHUGAI SEIYAKU KABUSHIKI KAISHA) 24 October 1984 see the whole document ---	1-8
A	US,A,4 143 144 (H.K. TOBOL ET AL.) 6 March 1979 cited in the application see claims 1,12; examples ----	1-8

¹⁰ Special categories of cited documents:

- ^{"A"} document defining the general state of the art which is not considered to be of particular relevance
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- ^{"L"} document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- ^{"O"} document referring to an oral disclosure, use, exhibition or other means
- ^{"P"} document published prior to the international filing date but later than the priority date claimed

^{"T"} later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention^{"X"} document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step^{"Y"} document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.^{"Z"} document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

09 MARCH 1992

Date of Mailing of this International Search Report

17 MAR 1992

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

P. BOSMA



ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. US 9107801
SA 53906

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 09/03/92

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